WORLD RESOURCES INSTITUTE

Working Paper

DATA MANAGEMENT SYSTEMS FOR NATIONAL GREENHOUSE GAS INVENTORIES: INSIGHTS FROM TEN COUNTRIES

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EXECUTIVE SUMMARY

Data management systems are critical for developing and regularly updating national greenhouse gas (GHG) inventories that, in turn, are foundational to national and international GHG mitigation efforts. However, limited information exists regarding national GHG inventory data management systems. This working paper summarizes survey responses from ten Parties—six Annex I (developed) Parties and four non-Annex I (developing) Parties—regarding data management systems for national GHG inventories. It presents information on some common features of existing Annex I Party data management systems and provides details about the various capacities and resources required to support them. It also identifies relevant capacity challenges faced by non-Annex I Parties as they seek to establish a robust national GHG inventory data management system.

Based on the survey responses from Annex I Parties, this working paper also provides some insights regarding the design, building, and management of an effective data management system. These insights include the need to:

- Understand specific reporting objectives before building the data management system
- Support data management systems with clear institutional arrangements
- Provide sufficient funding for system development and maintenance, consistent with goals and objectives

CONTENTS

Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.

Suggested Citation: Damassa, T. and J. Blumenthal with S. Elsayed. 2015. "Data Management Systems for National Greenhouse Gas Inventories: Insights from Ten Countries." Working Paper. Washington, DC: World Resources Institute. Available online at www.wri.org/publication/data-management-ghg-insights.

- As appropriate, link to or build on existing technical systems
- Adopt a flexible approach to system design and development

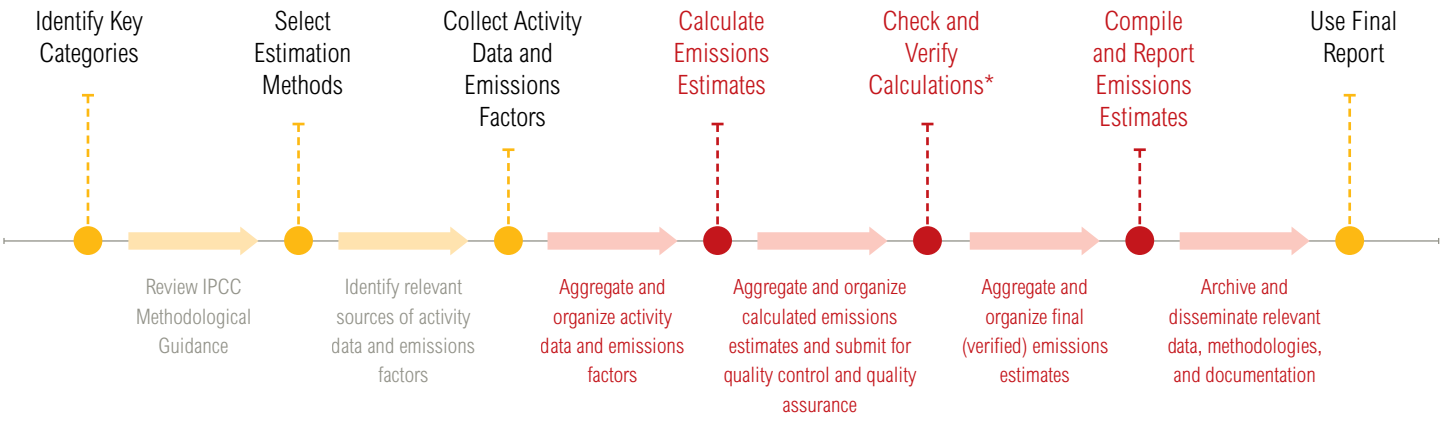
This working paper aims to assist GHG practitioners seeking to implement or further develop their own GHG data management solutions, as well as to inform potential donors and capacity-building organizations seeking to support non-Annex I Party national GHG inventory systems and enhance domestic systems for GHG measurement and reporting.

INTRODUCTION

A national greenhouse gas (GHG) inventory is an estimate of the total quantity of GHGs emitted and removed because of human activities each year (IPCC, 2006). A national GHG inventory provides critical information regarding a country's emissions profile and it can be an important tool for assessing progress toward meeting national emissions reduction goals and for prioritizing policies and actions. Under the United Nations Framework Convention on Climate Change (UNFCCC), countries (referred to as "Parties") that signed the Convention are required to submit a periodic national GHG inventory report. Annex I Parties[1] submit national GHG inventories annually, while non-Annex I Parties[2]—prior to 2014—included a national GHG inventory report as part of their National Communication submission,[3] which varied in frequency.[4] As of 2014, non-Annex I Parties, with the exception of least developed Parties and small island states, are expected to submit reports every two years, which will contain, among other inputs, a recent inventory of national GHG emissions and removals (UNFCCC, 2011).

In light of these new international reporting requirements, and the importance of accurate national GHG inventories for domestic GHG mitigation efforts, many non-Annex I Parties are working to improve the quality, efficiency, and sustainability of their national inventory systems (MAPT Project, 2014a,b). A national inventory system, in this working paper, is defined to include all the institutional, human resource, financial, and technological capacities[5] necessary to develop a comprehensive national inventory

Figure 1 | **Steps in a General National GHG Inventory Development Process and Possible Roles of a Data Management System**



*Quality control and quality assurance (checks and verification) ideally should be conducted throughout the development of a national inventory process, but are included here as a single step for the sake of simplicity.

Sources and Notes: Adapted from PMR (2013), Figure 1; Singh et al. (2014), Box 2; and IPCC (2006). Major steps in the national inventory process are identified by circles, separated by intermediate or enabling steps (arrows). Aspects of the GHG inventory development process commonly supported by a data management system (in whole or in part) are highlighted in red. However, readers should note that this schematic is general—the scope of a national inventory data management system and its role within the broader national GHG inventory process will be country specific.

report, as described by Intergovernmental Panel on Climate Change (IPCC) guidance (for example, IPCC, 2006).[6] In addition to the development of important enabling arrangements and processes (see Damassa and Elsayed, 2014), a national GHG inventory data management system (hereafter, "data management system") is a critical element of a sustainable national GHG inventory system (see Figure 1). This working paper defines a data management system as comprising the technologies, people, and processes that support data management for producing a national GHG inventory.[7]

Despite the importance of data management systems, limited public information is available regarding their operation in various countries. A 2013 report published by the World Bank's Partnership for Market Readiness (PMR) provides an overview of the data management systems of four Annex I Parties. It presents lessons learned, based on these Parties' experiences, as well as several design considerations for data management systems. WRI's Measurement and Performance Tracking (MAPT) project[8] sought to build on PMR's research by providing additional insights regarding data management systems specific to national inventories, with a focus on the enabling capacities.

In consultation with national GHG inventory experts, MAPT developed a survey (see Appendix) to gather information about existing data management systems and identify implementation constraints in countries that do not yet have their own data management systems. The survey was circulated to national GHG inventory practitioners in Annex I and non-Annex I Parties either directly or via the networks of international organizations, such as the Low Emission Capacity Building Programme of the United Nations Development Programme (UNDP), which supports national GHG inventory system development.[9] Voluntary responses were received from representatives of ten countries: six Annex I Parties (Austria, Germany, Hungary, the Netherlands, New Zealand, and the United Kingdom) and four non-Annex I Parties (Ecuador, Lebanon, Mexico, and Morocco).

Because of the limited number of survey responses received, the information presented in this working paper might not be broadly representative and should be interpreted as Party- and context-specific. In addition, responses generally reflect the views of a single Party expert and have not been extensively validated (for example, through multiple interviews) to assess completeness or accuracy. A comprehensive review and evaluation of Parties' data management systems, as well as detailed guidance for selecting or developing a data management system, are therefore beyond the scope of this study.

The purpose of this working paper is to provide a summary of selected Party experiences that were highlighted by respondents in their completed surveys. It presents major features of operational data management systems identified by Annex I Party respondents and some challenges to implementing data management systems identified by non-Annex I Party respondents.

Although examples of operational data management systems do exist in non-Annex I Parties,[10] Annex I Parties, including those represented in our survey sample, generally have greater experience with reporting a national GHG inventory and maintaining a data management system. This working paper therefore uses Annex I Party experiences shared through the survey responses to provide further insights concerning the resources and capacities necessary to develop and maintain a data management system over time.

This working paper aims to support, in particular, non-Annex I Party GHG inventory practitioners and system designers who are considering the creation or further development of their own data management systems. It also offers useful information for non-governmental and international organizations working to develop capacities that support non-Annex I Party national GHG inventory systems.

FEATURES OF ANNEX I PARTY DATA MANAGEMENT SYSTEMS

The six survey responses received from Annex I Parties demonstrate that data management systems can vary considerably in terms of their functions, forms, operational resources, and system access arrangements, depending on a country's specific context. Importantly, Annex I Parties have over a decade of experience in reporting annual national GHG inventories. As a result, the development and refinement of their data management systems have also occurred over many years (see, for example, PMR, 2013). The iterative process of data management system development is important to bear in mind, although it is not explicitly captured in the information presented here.

Data Management System Functions

According to responses from the six Annex I Party surveys, their data management systems support most, if not all, of the following functions:

- aggregation and storage of activity data, emission factors, and calculated emissions totals;
- data analysis and emission calculations;
- documentation of procedural information and published national inventory methodologies;
- facilitating quality assurance and quality control (QA/QC);
- reporting to the UNFCCC or another entity;
- data sharing among the national inventory team, government agencies, and others; and
- archiving of datasets, calculations, documentation, relevant studies, communications among inventory team members, and final submitted reports.

Data Management System Forms

Although the data management systems described by the six Annex I Party survey respondents fulfill similar functions, they take several different forms (Table 1). For example, according to the respondent from Austria, the "core" database is constructed from Excel spreadsheets and uses Visual Basic for Applications (VBA) macros. Austria's National Inventory Report (2014) states that these two features combined create "a very flexible system that can easily be adjusted to new requirements."[11] Alternatively, the respondent from Germany describes a data management system that uses specialized software[12] and has the ability to handle complex roles and functions. Other countries in the survey sample use a data management system that combines elements of a customized database and customized Excel spreadsheets or Access databases, among other tools. Customized Excel spreadsheets were often used to gather activity data for the GHG inventory and perform calculations for data analysis.

Table 1 | **Data Management System Types Identified in Survey Responses from Six Annex I Parties**

EXCEL-BASED	SPECIALIZED SOFTWARE	COMBINATION OF EXCEL/ACCESS AND SPECIALIZED SOFTWARE
Austria	Germany	New Zealand
Hungary		United Kingdom
		Netherlands

Data Management System Operational Resources

According to the Annex I Party respondents, the development and maintenance of their current data management systems require managerial skills and specific technical knowledge. For example, the respondent from Germany noted that the data management system manager possesses administrative skills and a working knowledge of systems analysis. The respondent from Hungary suggested that an understanding of current national inventory requirements, including sector-specific emission calculation methodologies, is needed. The respondent from Austria stated that, to effectively manage Austria's data management system, the following knowledge and skills are required: "excellent knowledge of Microsoft Windows operating system, Microsoft Office (Word, Excel, Access, PowerPoint), MS-Visual Basic, database (Oracle and SQL), Security (Firewall, Backup), [and] knowledge of statistics." To support data management system proficiency and skill development, Parties might require periodic (for example, annual) technical trainings for staff in using the data management system. According to the respondent from Germany, inventory staff members are encouraged to take introductory user training courses, which often last three to five days. The response from the Netherlands highlighted database management system training, Geographic Information System (GIS) training, and website development training as relevant to their system.

In addition, Annex I Party responses suggest that different levels of human resources can be employed to implement a data management system. The respondent from the Netherlands identified three individuals who support the development of the country's data management system: a half-time employee working on database management; a full-time software engineer; and a full-time GIS expert to support sub-national disaggregation of the information for

related modeling work.[13] The respondent from Hungary suggested that "an expert from every main sector" is needed, and noted that "sectoral experts might fulfill other roles…such as management of the submissions, QA/QC, [and] documentation and archiving issues." By contrast, the respondent from Austria noted that the country has a single database manager who compiles the inventory data. The respondent from Austria also estimated that one person on the inventory team worked 60 days to develop the data management system and another staff person works three days per year to maintain it (excluding the process of reporting the final inventory to the UNFCCC).[14]

Data Management System Access Arrangements

The six Annex I Parties surveyed provide several insights regarding user access structures for data entry and operation of the data management system. For example, the respondent from the Netherlands stated that data management system access is provided to about 40 experts working across ten organizations, including research institutions, consulting firms, and government agencies. Likewise, the respondent from Germany noted that a team of more than 50 people works across agencies on the GHG inventory and requires access to the data management system. Generally, experts at the German Federal Environment Agency and involved third parties are responsible for direct data entry and importing aggregated/calculated values. However, for certain sectors, such as agriculture, the same respondent noted that emissions estimates are calculated outside the Federal Environment Agency and later transferred to the data management system from another institute via a standard interface. The practice of enabling data providers, experts, and project partners to contribute to the data management system began in 2008, according to Germany's National Inventory Report (German Federal Environment Agency, 2014).

Respondents noted that, where user access structures are decentralized, inventory staff, typically, have additional access privileges to the inventory management system. For example, the UK respondent stated that inventory staff in the lead inventory agency are responsible for "uploading, calculating, and quality checking the data" and thus have direct access to the data management system; access to the system by the full Department of Energy and Climate Change is restricted. Similarly, the respondent from the Netherlands noted that their data management system enables inventory experts to upload a subset of inventory data online for the public to access, while providing a more detailed dataset to inventory staff.

Finally, after the emissions data are collected, processed, analyzed, and stored, several Annex I Party respondents noted the importance of being able to transmit inventory data to the entire inventory team. For example, in New Zealand, the national inventory compiler and sector leads are responsible for information sharing and communications among all experts directly involved in the inventory compilation and/or QA/QC procedures. According to the respondent, the data management system allows inventory staff to exchange methodological notes and messages—so that experts are regularly updated—and also serves as a place to keep the most commonly used reference materials and guidelines, so that they may be accessed easily by inter-agency inventory personnel.

CAPACITY CHALLENGES TO DATA MANAGEMENT SYSTEM IMPLEMENTATION IDENTIFIED BY NON-ANNEX I PARTIES

Many non-Annex I Parties are prioritizing the development of a data management system to improve their national inventory system (which, in turn, can lead to more accurate and robust national inventories and more targeted policymaking) (MAPT Project, 2014a). Survey responses from four non-Annex I Parties—Ecuador, Lebanon, Mexico, and Morocco—all indicate that developing a data management system is a priority for their national GHG inventory system. Despite being in various stages of developing their national GHG inventory systems, respondents often noted similar characteristics for their preferred data management system. For example, some common, critical functional needs that were identified include:

- efficiently managing activity data and emission factors;
- ensuring consistency with IPCC methodologies for national inventories;
- calculating, analyzing, and archiving GHG emissions data;
- sharing data among individuals and inventory-related agencies and organizations;
- verifying data with a reliable QA/QC system; and

- documenting methods, data sources, and relevant communications and contacts.

Respondents noted that accessing the data management system through the Web would provide for convenience and ensure a system of security.[15] In addition, all non-Annex I Party respondents noted the importance of an inclusive system design that allows institutions providing relevant GHG inventory data to have access to the data management system. They also noted the importance of providing access to GHG-related information for a diverse set of users, including researchers, non-governmental organizations, and policymakers.[16]

Although there is some clarity on which features to include, implementation of a data management system remains a challenge in the four non-Annex I Parties surveyed because of several capacity constraints. Major challenges that were identified are summarized below.

- **Institutional Capacity Challenges.** All four non-Annex I Party respondents noted difficulties in establishing effective institutional arrangements to support efficient data management processes. For example, the respondent from Lebanon noted "conflicting and overlapping mandates" among government institutions, as well as a lack of clear institutional frameworks and legal structures requiring government institutions to report information to the national inventory coordinating body. The respondent from Morocco similarly cited the absence of a designated lead government agency to manage the national GHG inventory as a major barrier to data management system implementation. Although Mexico has a more established set of institutional arrangements (MAPT Project, 2014b), challenges remain—for example, it was noted that information technology and inventory expert groups supporting the national GHG inventory system work independently, sometimes complicating communications.[17] The lack of clear mandates and communication channels can contribute to unclear staff responsibilities (Damassa and Elsayed, 2014), which can lead to gaps in reporting data and/or duplicative efforts, hindering the effectiveness of a data management system.

- **Financial Capacity Challenges.** Non-Annex I Parties might also face financial constraints relating to the funding of national inventory system work (Finnegan et al., 2014), including the development of data management systems. As Mexico's survey response highlighted, funding is an issue because the implementation of national inventory systems requires several years. Financial constraints, according to the respondent from Lebanon, include a large fixed cost to develop the system, in addition to high operating, maintenance, and hosting expenses. Sufficient funding to pay technical staff to maintain the data management system is also an issue, as identified by the respondent from Ecuador.

- **Human Resource Capacity Challenges.** Human resource capacity challenges identified by respondents from the non-Annex I Parties include a lack of staff experience with implementing a national GHG inventory system and the need for more staff. Inadequate staff experience can involve a lack of expertise on the IPCC Guidelines[18] and emission calculation methodologies, UNFCCC reporting guidelines, and sectoral GHG management and measurement. As for staff shortages, the respondents from Mexico and Morocco noted that there is limited capacity to provide technical assistance at the sub-national level. The respondent from Mexico further highlighted that the team of five experts working to develop the national GHG inventory is also expected to serve on working groups focused on managing GHG emissions. This workload stretches their ability to engage fully with the national GHG inventory system.

DISCUSSION: INSIGHTS FOR DEVELOPING AND MAINTAINING A DATA MANAGEMENT SYSTEM

Although there is no "one-size-fits-all" solution to addressing the capacity challenges noted above, survey responses from Annex I Party respondents provide some insights regarding the development and ongoing support of data management systems:

Understand specific reporting objectives before building the data management system

Design choices made by a Party, regarding the technical specifications and operation of a data management system, have significant implications for its fitness for purpose. For example, uncertainty in system and/or process design may cause misalignment with existing institutional processes. This can lead to a lack of organizational support and human resourcing. Design uncertainties can also result in insufficient budgeting and inadequate system attributes and functions.

Therefore, understanding international (that is, UNFCCC and IPCC) and domestic reporting objectives and requirements, as well as the type and quality of data needed to achieve these objectives, can help countries to ensure that their data management system is fit for purpose. To identify data needs that respond to international GHG data requirements, practitioners can turn to the IPCC Guidelines and participate in workshops held by the UNFCCC Secretariat or other entities.[19] Further information on critical GHG inventory data can be obtained through consultations with statistical offices, private industries, and other national experts. The respondent from New Zealand recommended that countries seeking to develop a data management system should perform a data requirements analysis through consultations with sector experts "to ensure that [the] system's scope meets the needs of the data owners, compilers, and analysts."

Support data management systems with clear institutional arrangements

One way to establish strong oversight of the data management system is to place it under a single lead government institution or agency, which might make it easier for the agency to coordinate data collection and develop the system over time. Legal mandates might also enable the lead agency to collect data necessary for the GHG inventory. This is the case in Hungary, where the Hungarian Meteorological Service has such a mandate.[20] In Austria, legally based data-sharing agreements[21] have been established between the Environment Agency Austria and both the statistical office and the Ministry of Environment. The establishment of formalized data-sharing arrangements can help to strengthen national institutions' accountability for data collection and facilitate the sharing of data compilation tasks, which can, in turn, enhance overall national government support for and ownership of a data management system.

In addition, if a national inventory system is already wholly or partially established, aligning data management system processes with the institutional arrangements for the broader national GHG inventory system can help to ensure adoption among relevant government agencies. For example, New Zealand's data management system reflects the decentralized structure of its national inventory system, where different government agencies working on different software platforms are responsible for collection, processing, and compilation of the GHG inventory information for different sectors, prior to aggregation and synthesis by the lead inventory agency.

Provide sufficient funding for system development and maintenance, consistent with goals and objectives

GHG data management systems can vary widely in terms of their setup cost because of differences in their scope, hardware and software specifications, and other factors such as the degree of integration with other systems.[22] According to survey responses, the upfront costs for software development for a national inventory data management system range between tens and hundreds of thousands of U.S. dollars.[23] Respondents also reported that annual maintenance costs range from 10 to 20 percent of the software's initial cost, although the respondent from Germany noted that these costs are often incremental, because system investments are made over a period of years.

Different elements of the data management system require different approaches in terms of finances needed for upgrades and updates. For example, the portions of the system that handle reasonably static operations, in which functions and attributes do not experience significant changes on a yearly basis, require lower upgrade costs. In contrast, the parts of the system that are likely to undergo frequent changes or re-engineering, because of inventory methodological developments and planned improvements, might require more significant investments in annual upgrades. The respondent from New Zealand reported that planned upgrades—for example, due to significant changes in methodology—of some elements of the system that are used to process data, could amount to 60 to 80 percent of the total initial cost for a certain period of time.

To maintain a data management system over time, survey responses also suggest that budgets might need to include line items for customized calculations, a QA/QC system, staff time, the costs of Excel and/or Access user licenses, costs related to network and/or PC administration, security, servers, and backup systems. Funding to support the data management system therefore should be allocated regularly, for example, through a legal or policy framework or national budget line item (Cheung et al., 2014). To do this, countries could consider augmenting funds received from international sources (for example, the Global Environment Facility) with domestic sources of funding, or implementing the construction of a data management system in discrete stages to minimize costs.

As appropriate, link to or build on existing technical systems

Parties might also consider leveraging or linking existing systems that are used for storing and processing other information, such as air pollutant data, to GHG data management systems.[24] This approach could leverage broader resources and also foster greater political or inter-agency acceptance. For example, national sales statistics or facility-level data could be used for verification of the national inventory data if the respective data management systems were linked and had appropriate data exchange standards and protocols (PMR, 2013; Singh et al., 2014). As one example, the Netherlands data management system serves as the repository for GHG and non-GHG (that is, water, waste, and soil) pollutant data for reporting at the national and international (European Union and United Nations) levels. According to the Netherlands' latest National Inventory Report (National Institute for Public Health and the Environment, 2014), the country's national GHG inventory is based on data from its Pollutant Release and Transfer Register. This shared underlying data "ensures consistency between the inventories and other internationally reported data."

A Party might also benefit from acquiring or customizing existing software rather than developing a system from scratch. This approach could involve consolidating and harmonizing existing data sets and data models, thereby creating an opportunity to improve the transparency and consistency of the Party's GHG data, and enhance reporting efficiency.

Adopt a flexible approach to system design and development

GHG reporting is a very dynamic field, where data processing methodology and data modeling are highly dependent on developments in science and technology. In addition, the functional requirements of a data management system differ by country and vary even across a country's economic sectors. Therefore, it is advisable to adopt an approach to data management system design that can evolve with a Party's national inventory system and that enables a Party's timely response to changing needs and priorities, while ensuring that financial resources are wisely allocated.

For example, New Zealand's response suggests that some Parties might wish to take a stepwise approach to building the data management system so that the system is developed in phases. This approach might be appropriate if resources are constrained. For example, a Party might decide to pilot the system in one sector or create a system for only a specific stage of inventory development, and then continue system development when additional resources become available.

Alternatively, Parties with resource constraints and/or uncertainty regarding the system's scope and technical specifications, might consider using available free-of-charge data management systems. Such software is available from the UNFCCC,[25] IPCC,[26] and U.S. EPA/ Colorado State University[27]. This is a low-cost option that provides an adequate level of data management facilities in line with the IPCC guidelines. Although a Party may ultimately choose to develop a customized system to match its specific needs for GHG inventory data management, this approach allows Parties to spend more time detailing their future designs for a country-specific data management system, while accumulating sufficient resources.

Concluding Thoughts

As non-Annex I Parties contemplate implementing data management systems to support national GHG inventories and reporting initiatives, the survey responses compiled here illustrate several important issues that should be taken into consideration by practitioners:

- The scope of the system
- The approach to the system's design and implementation
- Human resources and institutional considerations involved in system management
- Costs involved in the project

Although this working paper highlights a range of relevant technical attributes and options related to these data management system issues, additional topics that should be considered by Parties seeking to establish a data management system, and that could be proposed for future study, include:

- Matching the type of the data management system with country-specific national circumstances (considering factors such as data availability and reporting standards, resource availability and expenditure trade-offs, national economic structure, national and sub-national government structures and agency responsibilities, government climate-change policies and regulations, and government climate-change information goals)
- Comparing advantages and disadvantages of particular technical features of different systems
- Specific requirements for developing human resources (including staff structures, skills, and training) that are adequate to managing the GHG data management system, and maintaining sufficient financial resources
- Party-specific system acquisition strategy (for example, in-country development versus outsourcing) and its implications for system ownership, maintenance, and costs

Future additional studies would probably benefit also from broader Party participation and greater representativeness of data management systems.

Finally, if Parties' regularly shared their experiences regarding the development and improvement of data management systems with the international climate-change community, that would help to enhance understanding of the strengths, weaknesses, and capacity requirements for building and maintaining data management systems, and would improve the completeness and reliability of the inventory data. It would also improve decision-making in the design and development of national GHG inventory data management systems, better enabling Parties to achieve their goals for developing sustainable national GHG inventory systems.

APPENDIX: SURVEY OF DATA MANAGEMENT SYSTEMS FOR NATIONAL GHG INVENTORIES

The Measurement and Performance Tracking (MAPT) project works to build national capacities in developing countries and major emerging economies to measure greenhouse gas (GHG) emissions and track performance toward low-carbon development goals. WRI supports existing domestic efforts through a combination of tools, case studies, trainings, and guidance. In order to address the cross-cutting nature of GHG measurement and management, MAPT comprises a number of components, each targeting a specific dimension of the measurement and tracking system. One such component is a focus on national GHG inventories, which allow countries to quantify GHG emissions from key sources and sinks.

As part of the project scoping, MAPT carried out an assessment of national inventory capacity needs in Brazil, Ethiopia, India, South Africa, and Thailand. A number of inventory practitioners in these countries identified the development of a data management system as a key priority for further enhancing the efficiency of their national inventory process.[28]

A system for data management encompasses both processes, such as collecting, inputting, storing and sharing data, and the technical system(s) used to facilitate these tasks. Such a system might have one or more of the following functions:

- A repository for GHG emissions data (including calculated emissions estimates, activity data, emission factors)
- Documentation of the inventory process (for example, methodologies used, relevant data sources)
- Archiving of historical data and information
- A means to share data between staff/institutions within a country; to share data between governments and the public; and to share data among countries to facilitate cooperation
- Analysis of GHG data

Depending on its primary function and sophistication, the type of technical system used can vary widely. Below are a few examples of the different systems and technologies that could be applied to perform key functions:

FUNCTION	EXAMPLES OF SYSTEMS/TECHNOLOGIES
Data Repository/ Archiving	Database; Spreadsheets (for example, Excel)
Documentation	Wiki; Static document (for example, Word/PDF)
Data Sharing/ Reporting	Web portal; Emails
Analysis	UNFCCC Software; IPCC Inventory Software; U.S. EPA ALU Tool

WRI is developing an assessment to explore the various technical systems that countries have in place to facilitate inventory data management, and the capacities required to develop these systems. Your input into this survey will help to enrich the case study with country experiences.

Respondent Information

Name:

Email:

Institution:

Country:

Can we include this information in the report?:

If your country currently has a technical system for managing GHG data please answer ***Section A****.*

If your country does not have a system please answer the questions in ***Section B****.*

Section A (answer if you DO have a data management system)

DESCRIBE THE ATTRIBUTES OF THE SYSTEM

1. **Describe your primary data management system.** (For example: Is it a customized database, web-based system, customized Excel spreadsheet, etc.?)
2. **What type of data does this system collect?** (For example: GHG emissions data, procedural information, methodologies, etc.)
3. **What are the key functions of this system?** (For example: repository, archiving, data sharing, data analysis, documentation, etc.)
4. **Describe the technical specifications of the data management system** (For example: What program is being used to manage the database/back-end/front-end/user interface?).
5. **How is the system accessed?** (For example: Is it web-based, downloaded on a computer, etc.?)
6. **Who are the main users?** (For example: Who uploads and downloads this data? Which institutions and staff? Is it a centralized process or decentralized?)
7. **How often are data updated?**
8. **What are the levels of privacy/information access?** (For example: Can the public access this data? Only national inventory staff? etc.)

DESCRIBE THE CAPACITIES NEEDED TO DEVELOP AND MAINTAIN THE SYSTEM

1. **Did the data management system for the national inventory system build off an existing system(s)?** If so, what was the purpose of this precursor system? What were the most important attributes/functions that made it a suitable precursor to managing data for the national GHG inventory system?
2. **What was the process for initially developing the national inventory data management system?** (For example: What consultations took place? Were any data sharing agreements developed?)
3. **Discuss the financial capacities required for the development and maintenance of the data management system(s).** (For example: What were the estimated costs associated with the initial development of the system? Please specify quantitatively. What are the most expensive aspects associated with the maintenance of the system – for example, data collection, calculation & method development, QA/QC (including consultation), IT systems, etc.?)
4. **Discuss human resource capacities that contributed to development and maintenance of the data management system(s).** (For example: How many staff members are involved in the management of the data system(s)? What are the functions of the team?)
5. **What type of specialist knowledge is needed for the management of the system?** If staff training was needed, please describe the process for building human resource capacity. What training was offered?
6. **What recommendations would you make for other countries seeking to develop a system for managing inventory data?**

Section B (answer if you DO NOT have a data management system)

DESCRIBE THE ATTRIBUTES OF A POTENTIAL SYSTEM	
1. **Is developing a technical system for the management of GHG data a current priority for your inventory system?**	
2. **What type of data would you want this system to collect? If more than one please rank in order of priority.** (For example: GHG emissions data, procedural information, methodologies, etc.)	
3. **What are the key functions you would prioritize in a system? If more than one please rank in order of priority.** (For example: repository, archiving, data sharing, data analysis, documentation, etc.)	
4. **What is your preference for how the system would be accessed?** (For example: web-based, downloaded on a computer, etc.)	
5. **Who would need access to this system? Who would be the main users?** (For example: Who uploads and downloads this data? Which institutions and staff? Is it a centralized process or decentralized?)	
6. **Describe any existing national systems that a new GHG management system could build off** (for example, an air pollution data management system). **What are the strengths and weaknesses of this system?**	

DESCRIBE THE CAPACITY CONSTRAINTS HINDERING THE DEVELOPMENT OF A SYSTEM	
1. **Describe any technical constraints hindering the development of the system (if any). What specialist knowledge needs to be built?**	
2. **Describe any financial constraints hindering the development of the system (if any).**	
3. **Describe any human resource constraints hindering the development of the system (if any).**	
4. **Describe any institutional constraints hindering the development of the system (if any).**	

ACRONYMS AND ABBREVIATIONS

GHG	Greenhouse gas
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
MAPT	Measurement and Performance Tracking
PMR	Partnership for Market Readiness
QA/QC	Quality Assurance/Quality Control
UNFCCC	United Nations Framework Convention on Climate Change
VBA	Visual Basic for Applications

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ENDNOTES

1. For a list of Annex I Parties to the Convention, see https://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php.
2. For a list of non-Annex I Parties to the Convention, see http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php.
3. For more information on National Communications reports submitted by non-Annex I Parties, see http://unfccc.int/national_reports/non-annex_i_natcom/items/2716.php.
4. A list of submitted non-Annex I National Communications is available at https://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php.
5. For more information regarding capacity definitions, see MAPT Project, 2014a.
6. For more information about national GHG inventory systems, please see IPCC, 2006. For an illustrative schematic of a national GHG inventory system, see p. 71 of German Federal Environment Agency, 2014.
7. This definition is well aligned with those of other sources: for example, PMR (2013) defines a data management system as "the technologies and processes that facilitate data collection and organization for use to meet climate change-related policy objectives."
8. Through the deployment of tools, trainings, and analysis, MAPT seeks to build developing-country capacity for designing and implementing national measurement and tracking systems to meet domestic low-carbon growth and emissions-mitigation goals. For more information, see http://www.wri.org/our-work/project/measurement-and-performance-tracking-developing-countries.
9. For more information, see www.lowemissiondevelopment.org.
10. See, for example, case studies from South Africa, which provide an overview of the South African Air Quality Information System (Witi and Jeng, 2013; Manzini et al., 2013). These case studies are available at no cost at https://sites.google.com/site/maptpartnerresearch/national-ghg-inventory-case-study-series/national-ghg-inventory-data-management-systems.
11. See p. 33 of Environment Agency Austria, 2014.
12. Developed and maintained by a German company, the software processes data on an Oracle database and a Microsoft database server (SQL) and includes built-in VBA and .NET functions.
13. According to the survey respondent from the Netherlands, a GIS expert is needed to disaggregate national emissions to the local level so that modelers compiling air quality and water information can use the data.
14. For comparison, Austria's respondent estimates that the entire national inventory team spends an average of 300 days per year on data collection, calculations, and QA/QC activities.
15. Mexican experts provided an example of how their platform might look online: http://www.objetivosdedesarrollodelmilenio.org.mx/cgi-win/ODM.exe/INDODM007000100010,44,0,000,False,False,False,False,False,False,False,0,0.
16. Respondents from Lebanon, Mexico, and Morocco also suggested that the process of uploading data should be closely overseen by the single lead national institution. As noted in the response from Morocco, such an approach would enable data providers and sectoral partners to upload data, reducing the lead agency's responsibilities, but also provide greater security of the information.

17. Personal communication – 11/24/2014.
18. http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html and http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.
19. For example, see http://www.uncclearn.org/unfccc_trains_national_focal_points_use_ghg_invent, http://unfccc.int/resource/cd_roms/na1/ghg_inventories/index.htm, and http://www-gio.nies.go.jp/wgia/wgiaindex-e.html.
20. According to Hungary's National Inventory Report for 1985-2012, a government decree designated the Hungarian Meteorological Service as the "compiler institute" in 2009. The Service is a central office within the Ministry of Rural Development (Hungarian Meteorological Service - Greenhouse Gas Inventory Division, 2014).
21. "In order to comply with the reporting obligations, the Umweltbundesamt [Environment Agency Austria] has the possibility to obtain confidential data from the national statistical institute (of course these data have to be treated confidentially). The legal basis for this data exchange is the "Bundesstatistikgesetz" (federal statistics law), which allows the national statistical office to provide confidential data to authorities that have a legal obligation for the processing of these data" (p. 28, Environment Agency Austria, 2014).
22. According to PMR (2013), "'independent' data management systems are likely to have lower setup costs. 'Integrated' data management systems are likely to have higher setup costs and likely lower costs to implement future policy changes."
23. A direct comparison of costs is difficult given different years of system implementation, currency valuations, and system scope definitions among respondents.
24. Mexico and Morocco noted the potential for a GHG management system to be built from the air pollutant inventory management system in their countries, and Lebanon stated that this arrangement is already taking place in a limited way for the cement industry. For example, Mexico's pollutant release and transfer register tracks the release of chemical pollutants from industrial facilities. It provides information at the facility level by sector and also aggregates data from municipalities and states. Similarly, a platform in Lebanon reports pollutants from cement processing and provides an example of how to submit a single reporting template with cement-specific and GHG-specific data to the Ministry of Environment for inventory compilation. Although the survey respondents in these countries identified some weaknesses in their systems, the experience of developing and maintaining these platforms could provide important insights relevant to establishing a GHG data management system.
25. https://unfccc.int/national_reports/non-annex_i_national_communications/non-annex_i_inventory_software/items/7627.php.
26. http://www.ipcc-nggip.iges.or.jp/software/.
27. http://www.nrel.colostate.edu/projects/ALUsoftware/. The ALU tool supports the Agriculture and Land Use Sectors only.
28. For the complete MAPT scoping reports, which were written by partners in Brazil, Colombia, Ethiopia, India, South Africa, and Thailand, see: https://sites.google.com/site/maptpartnerresearch/home.

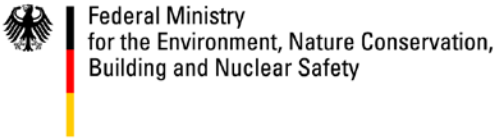
ACKNOWLEDGMENTS

The authors thank Soffia Alarcón-Díaz, Rebecca Carman, Loretta Cheung, Wee Kean Fong, Johannes Friedrich, Olia Glade, Kevin Hausmann, Sergey Kononov, Kelly Levin, Emily Matthews, Michael McCormick, and Neelam Singh for their thoughtful reviews and helpful comments, which greatly improved this paper. Thanks also to Hyacinth Billings, Emily Matthews, and Carni Klirs for providing editing and design support.

We are especially grateful for the contributions of the national inventory experts who responded to our MAPT survey and made this paper possible.

This work is supported by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) under its International Climate Initiative.

Supported by:



based on a decision of the German Bundestag

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ABOUT WRI

WRI is a global research organization that works closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.

Our Challenge
Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision
We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach
COUNT IT
We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT
We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT
We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.